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STUDIES ON BIO-EFFICACY OF NEWER INSECTICIDE MOLECULES AGAINST MAJOR SUCKING PEST COMPLEX OF PADDY

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ABSTRACT

The present study was conducted to evaluate the efficacy of some newer insecticides against the major sucking pests *viz*., *Nilaparvata lugens*, *Sogatella furcifera* and *Nephotettix virescens* in rice crop ecosystem during *kharif*, 2022 at wet land farm of S.V. Agricultural College, Tirupati, Andhra Pradesh, India. The different newer insecticides tested include spinetoram 11.7 SC @ 0.5 ml l^{-1}, cyantraniliprole 10.26 OD @ 1.2 ml l^{-1}, chlorfluzuron 5.4 EC @ 2.0 ml l^{-1}, tetraniliprole 18.18 SC @ 0.6 ml l^{-1}, pymetrozine 50 WG @ 0.6 gm l^{-1}, chlorantraniliprole 18.5 SC @ 0.3 ml l^{-1}, triflumezopyrim 10 SC @ 0.5 ml l^{-1} and sulfoxaflor 21.89 SC @ 0.7 ml l^{-1}. The highest mean per cent reduction of *N. lugens*, *S. furcifera* and *N. virescens* population over the control after two sprays was recorded with triflumezopyrim 10 SC @ 0.5 ml l^{-1} (76.24, 76.33 and 77.27 % respectively). The next highest mean per cent reduction of population was recorded with pymetrozine 50 WG @ 0.6 gm l^{-1} (73.72, 73.38 and 74.82 % respectively) followed by sulfoxaflor 21.89 SC @ 0.7 ml l^{-1} (70.28, 70.01, 72.04 %) and spinetoram 11.7 SC @ 0.5 ml l^{-1} (67.63, 67.21 and 68.02 % respectively). The remaining treatments were also significantly superior over untreated control in the management of sucking pest complex.

Keywords: Triflumezopyrim 10 SC @ 0.5 ml l^{-1}, Pymetrozine 50 WG @ 0.6 gm l^{-1}, Sulfoxaflor 21.89 SC @ 0.7 ml l^{-1}, *N. lugens*, *S. furcifera* and *N. virescens*, rice.

Introduction

The production of paddy in India is about 122.27 million metric tonnes and mean productivity of paddy in 2021 is 2713 kg ha^{-1}. West Bengal is the major paddy producing state accounting for 158.80 lakh tonnes production with an area of 54.90 lakh ha in the country followed by Uttar Pradesh, Punjab and Andhra Pradesh (www.statista.com). The total production of paddy is 130.89 lakh tonnes and total area in Andhra Pradesh in 2021-22 is 25.52 lakh ha and with a productivity of 5130 kg ha^{-1} (https://des.ap.gov.in).

Even though Andhra Pradesh has large area under cultivation, the average productivity of paddy is low when compared to national average due to abiotic and biotic factors. In Andhra Pradesh paddy is mainly grown in West Godavari, Eluru, East Godavari, Konaseema, Kakinada, Krishna and NTR districts, which receives good rainfall and provide favourable conditions for the crop. Apart from abiotic stress, paddy crop is subjected to ravages of insect pests and damage caused by sucking pest complex is considered as major limiting factor for yield. In general yield loss due to insect pests of rice has been estimated about 25% (Dhaliwal *et al*., 2010). Insect pests have been recognized as major biotic stress responsible for significant reduction in yield of rice in different parts of India (Chelliah *et al*., 1989). Therefore, it is necessary to manage sucking pest complex to increase the productivity.

A lot of insecticides have been found to be effective against the sucking pest complex in paddy. Many old insecticides that have lost their efficiency or become outdated in recent years owing to insect resistance or residual toxicity are being replaced by new generation compounds that are less harmful to mammals, birds and fishes while still having high insecticidal effectiveness. These new chemicals are less dangerous to natural enemies, honeybees and other pollinators than previous generations molecules (Singh and Kumar, 2012). To solve the drawbacks of conventional insecticides, various new compounds with unique chemistry and modes of action were introduced, necessitating testing their performance and the development of a more simple and cost-effective control method. Application of newer molecules has an excellent opportunity in the management of various pests as they are eco-friendly, pest-specific and less persistent. By considering the above, the current investigation "Studies on Bio-efficacy of newer insecticide molecules against major sucking pest complex of paddy" was undertaken.

Materials and Methods

To evaluate the efficiency of insecticides against sucking pest complex *viz*., Brown planthopper, *Nilaparvata lugens*; White backed planthopper, *Sogatella furcifera* and green leafhopper, *Nephotettix virescens* field experiment was carried out at wet land farm of S. V. Agricultural College, Tirupati during the *Kharif,* 2022. The experiment was carried out with nine treatments including untreated control laid out in a Randomized Block Design (RBD) with three replications. The size of the plots was 5 m X 5 m with inter-row spacing of 20 cm and 15 cm of intra-row spacing. The Insecticidal treatments were implemented *viz*., the first spray was imposed at 40 DAT (Days after transplanting) when the pest has crossed ETL and second spray at 60 DAT. Battery operated sprayer (high volume sprayer) was used for insecticidal spraying.

Observations Recorded

The brown planthopper was identified with the brownish nymphs and brownish adults. The white backed planthopper was identified with their yellow-coloured nymphs and hyaline adults having white streak at the junction of forewings. Similarly, the green leafhoppers were identified by the light green coloured nymphs and green winged adults having a black spot on the forewings and black patch on the posterior margin of the wing.

Population of both nymphs and adults of BPH, WBPH and GLH on 10 randomly selected hills per module were recorded, the data on population was recorded one day before (pre-treatment data) and 1, 5, 10 and 15 days after imposing treatments. Then per cent reduction of sucking pest complex over control were calculated in different treatments by using the modified Abbott's formula as given by Flemming and Ratnakaran (1985).

% Population reduction =

$$\left[1-\left(\frac{\text{post treatment population in treatment}}{\text{pre treatment population in treatment}}\right)\times\left(\frac{\text{pre treatment population in check}}{\text{post treatment population in check}}\right)\right]$$

The data generated were statistically analysed.

Results and Discussions

The data regarding the pre-treatment population and efficacy of two sprays were pooled together and the cumulative mean population and efficacy of the treatments against population of brown planthopper, white backed planthopper and green leafhopper are presented in table 1, 2 and 3 respectively.

The cumulative pre-treatment count of *N. lugens* (BPH) population per ten hills recorded a day before the application of insecticides including control ranged from 155.05 to 214.21 per 10 hills. At 10 Days After Spraying the mean population ranged from 29.38 to 144.70 per 10 hills in the treated plots and 280.58 in control (Table 1).

The overall mean efficacy of four observations recorded at one, five, ten and fifteen days after two sprays indicated that the plots treated with triflumezopyrim 10 SC @ 0.5 ml l^{-1} and pymetrozine 50 WG @ 0.6 gm l^{-1} recorded highest reduction of BPH population and remained significantly superior over all the other treatments with 76.24 and 73.72 per cent reduction over control respectively and were statistically on par with each other. The next effective treatments were sulfoxaflor 21.89 SC @ 0.7 ml l^{-1} and spinetoram 11.7 SC @ 0.5 ml l^{-1} with 70.28 and 67.63 per cent reduction over control respectively and were statistically on par with each other. The next treatment was cyantraniliprole 10.26 OD @ 1.2 ml l^{-1} with 64.50 per cent reduction over control followed by chlorantraniliprole 18.5 SC @ 0.3 ml l^{-1} and tetraniliprole 18.18 SC @ 0.6 ml l^{-1} with 42.58 and 40.80 per cent reduction over control respectively and were statistically on par with each other. Chlorfluzuron 5.4 EC @ 2.0 ml l^{-1} with 38.42 per cent reduction over control was least effective when compared to above treatments. However, all the treatments were significantly superior over untreated control in reducing the population of BPH. (Table 1 and Fig. 1)

The cumulative pre-treatment count of *S. furcifera* (WBPH) population per ten hills recorded a day before the application of insecticides including control ranged from 138.88 to 196.41 per 10 hills. At 10 DAS the mean population ranged from 27.94 to 147.95 per 10 hills in the treated plots and 270.66 in control (Table 2).

In case of white backed planthoppers the plots treated with triflumezopyrim 10 SC @ 0.5 ml l^{-1} recorded highest reduction of WBPH population and remained significantly superior over all the other treatments with 76.33 per cent reduction over control. The next effective treatments were pymetrozine 50 WG @ 0.6 gm l^{-1} with 73.38 per cent reduction over control followed by sulfoxaflor 21.89 SC @ 0.7 ml l^{-1} with 70.01, spinetoram 11.7 SC @ 0.5 ml l^{-1} with 67.21, cyantraniliprole 10.26 OD @ 1.2 ml l^{-1} with 64.17. Chlorantraniliprole 18.5 SC @ 0.3 ml l^{-1} and tetraniliprole 18.18 SC @ 0.6 ml l^{-1} with 41.52 and 39.90 per cent reduction over control respectively were statistically on par with each other. Chlorfluzuron 5.4 EC @ 2.0 ml l^{-1} with 36.84 per cent reduction over control was least effective when compared to above treatments. However, all the treatments were significantly superior over untreated control in reducing the population of WBPH. (Table 2 and Fig. 2)

The cumulative pre-treatment count of *N. virescens* (GLH) population per ten hills recorded a day before the application of insecticides including control ranged from 246.58 to 272.75 per 10 hills. At 10 DAS the mean population ranged from 41.54 to 171.70 per 10 hills in the treated plots and 314.83 in control (Table 3).

In case of green leafhopper, the plots treated with triflumezopyrim 10 SC @ 0.5 ml l^{-1} and pymetrozine 50 WG @ 0.6 gm l^{-1} recorded highest reduction of GLH population and remained significantly superior over all the other treatments with 77.27 and 74.82 per cent reduction over control respectively were statistically on par with each other. The next effective treatment was sulfoxaflor 21.89 SC @ 0.7 ml l^{-1} with 72.04 per cent reduction over control and was at par with pymetrozine 50 WG @ 0.6 gm l^{-1}. The next effective treatments were spinetoram 11.7 SC @ 0.5 ml l^{-1} and cyantraniliprole 10.26 OD @ 1.2 ml l^{-1} with 68.02 and 64.40 per cent reduction over control. However, both the treatments were significantly different from each other. The next treatments were chlorantraniliprole 18.5 SC @ 0.3 ml l^{-1} and tetraniliprole 18.18 SC @ 0.6 ml l^{-1} with 42.30 and 39.62 per cent reduction over control respectively were statistically on par with each other. Chlorfluzuron 5.4 EC @ 2.0 ml l^{-1} with 36.96 per cent reduction over control was least effective when compared to above treatments. However, all the treatments were significantly superior over untreated control in reducing the population of GLH. (Table 3 and Fig. 3).

Table 1 : Overall cumulative efficacy of insecticides against Brown Planthopper (BPH), *Nilaparvata lugens* during kharif, 2022.

S.No.	Treatment	Dose	PTP 10^{-1} hills	Mean number of BPH per 10 hills and per cent reduction of BPH population over control after spraying								
				1DAS		5 DAS		10 DAS		15 DAS		Mean Per cent reduction
				Mean	Percent reduction	Mean	Percent reduction	Mean	Percent reduction	Mean	Percent reduction	
T_1	Spinetoram 11.7 SC	0.5 ml l^{-1}	161.44	47.92	73.22 bc (58.89)	35.95	81.46 cd (64.54)	45.34	78.56 cd (62.42)	143.20	37.17 bc (37.59)	67.63 b (55.33)
T_2	Cyantraniliprole 10.26 OD	1.2 ml l^{-1}	157.27	52.14	70.16 c (56.91)	41.42	78.12 d (62.14)	51.13	75.14 d (60.16)	145.43	34.28 c (35.95)	64.50 c (53.44)
T_3	Chlorfluzuron 5.4 EC	2.0 ml l^{-1}	207.17	130.43	43.39 d (41.22)	123.36	50.45 f (45.30)	144.70	46.66 f (43.09)	254.39	12.97 d (21.16)	38.42 e (38.30)
T_4	Tetraniliprole 18.18 SC	0.6 ml l^{-1}	196.43	121.26	44.41 d (41.81)	110.49	53.24 ef (46.88)	131.14	49.02 ef (44.45)	231.97	16.44 d (23.92)	40.80 de (39.70)
T_5	Pymetrozine 50 WG	0.6 gm l^{-1}	155.05	31.73	81.58 a (64.62)	23.22	87.49 ab (69.38)	32.49	83.92 ab (66.45)	127.35	41.67 ab (40.27)	73.72 a (59.17)
T_6	Chlorantraniliprole 18.5 SC	0.3 ml l^{-1}	192.19	112.53	47.28 d (43.48)	105.24	54.57 e (47.63)	123.99	50.68 e (45.41)	223.63	17.65 d (24.85)	42.58 d (40.73)
T_7	Triflumezopyrim 10 SC	0.5 ml l^{-1}	164.10	29.09	84.03 a (66.52)	19.85	89.96 a (71.54)	29.38	86.33 a (68.34)	128.49	44.53 a (41.89)	76.24 a (60.83)
T_8	Sulfoxaflor 21.89 SC	0.7 ml l^{-1}	162.36	42.89	76.15 b (60.82)	30.79	84.21 bc (66.62)	40.45	80.94 bc (64.21)	138.25	39.67 b (39.07)	70.28 b (56.97)
T_9	Untreated control		214.21	238.21	0.00	258.13	0.00	280.58	0.00	302.72	0.00	0.00
SEm±					0.98		1.67		1.62		0.80	1.57
CD (5%)			Sig		2.88		4.05		3.94		2.36	2.83
CV (%)					4.11		5.23		5.12		5.76	4.07

Figures in parentheses are angular transformed values

PTP: Pre-treatment population

DAS: Days After Spraying

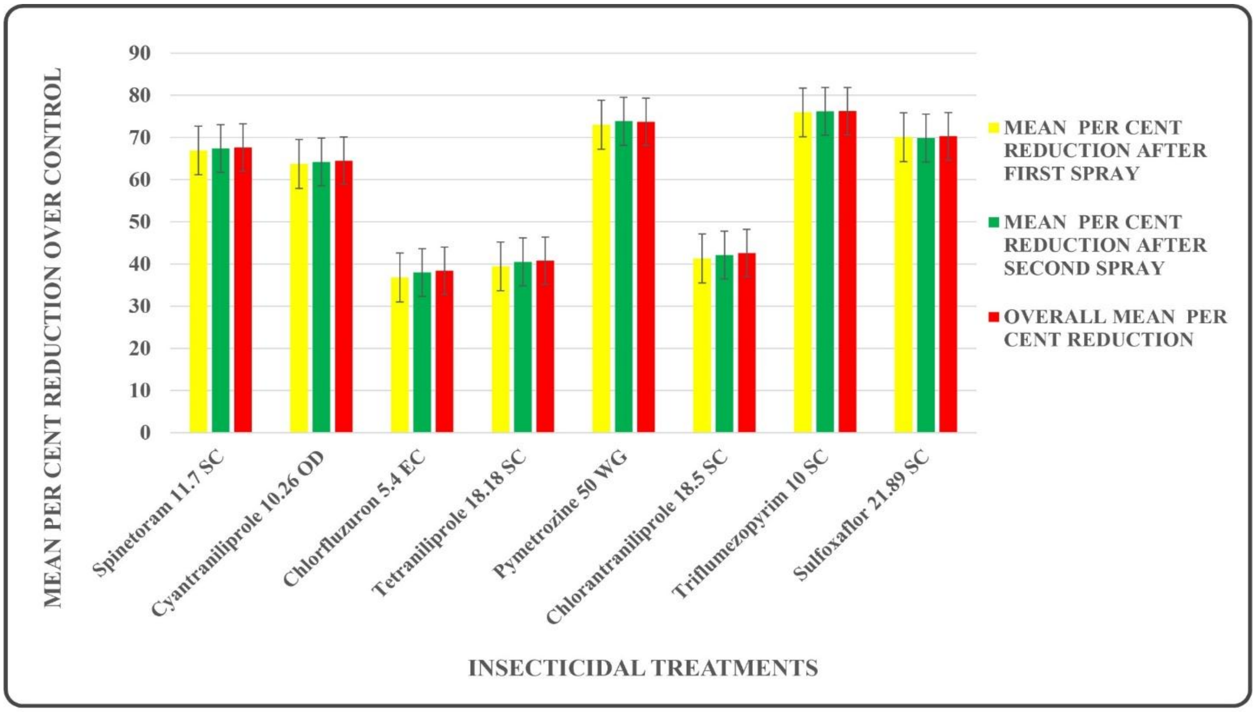

Fig. 1 : Mean effect of treatments after two sprays against brown planthopper during *kharif*, 2022

Table 2 : Overall cumulative efficacy of insecticides against White Backed Planthopper (WBPH), *Sogatella furcifera* during kharif, 2022.

S.No.	Treatment	Dose	PTP 10^{-1} hills	Mean number of WBPH per 10 hills and per cent reduction of WBPH population over control after spraying								
				1DAS		5 DAS		10 DAS		15 DAS		Mean Per cent reduction
				Mean	Per cent reduction	Mean	Per cent reduction	Mean	Per cent reduction	Mean	Per cent reduction	
T_1	Spinetoram 11.7 SC	0.5 ml l^{-1}	145.27	44.46	73.30^{b} (58.90)	35.04	80.82^{d} (64.03)	44.10	77.95^{c} (62.02)	136.97	36.72^{cd} (37.32)	67.21^{d} (55.07)
T_2	Cyantraniliprole 10.26 OD	1.2 ml l^{-1}	141.43	48.33	70.18^{c} (56.92)	40.24	77.37^{e} (61.60)	49.32	74.63^{d} (59.84)	138.48	34.25^{d} (35.91)	64.17^{e} (53.24)
T_3	Chlorfluzuron 5.4 EC	2.0 ml l^{-1}	191.13	126.75	42.24^{e} (40.55)	124.92	47.97^{g} (43.84)	147.95	43.81^{f} (41.44)	247.29	13.10^{f} (21.32)	36.84^{g} (37.37)
T_4	Tetraniliprole 18.18 SC	0.6 ml l^{-1}	180.30	116.36	43.79^{de} (41.44)	109.60	51.56^{f} (45.90)	131.20	47.19^{e} (43.39)	223.43	16.65^{ef} (24.25)	39.90^{f} (39.17)
T_5	Pymetrozine 50 WG	0.6 gm l^{-1}	138.88	29.70	81.41^{a} (64.51)	22.98	86.85^{b} (68.76)	31.90	83.34^{b} (65.91)	120.39	41.88^{ab} (40.33)	73.38^{b} (58.94)
T_6	Chlorantraniliprole 18.5 SC	0.3 ml l^{-1}	178.19	109.50	46.46^{d} (43.00)	105.29	52.92^{f} (46.68)	127.02	48.27^{e} (44.01)	217.16	18.28^{e} (25.35)	41.52^{f} (40.12)
T_7	Triflumezopyrim 10 SC	0.5 ml l^{-1}	148.26	27.40	83.89^{a} (66.37)	19.40	89.59^{a} (71.22)	27.94	86.32^{a} (68.31)	120.54	45.52^{a} (42.43)	76.33^{a} (60.89)
T_8	Sulfoxaflor 21.89 SC	0.7 ml l^{-1}	147.78	40.30	76.24^{b} (60.84)	30.58	83.52^{c} (66.05)	40.57	80.06^{c} (63.52)	131.93	40.14^{bc} (39.34)	70.01^{c} (56.80)
T_9	Untreated control		196.41	225.43	-	246.71	-	270.66	-	293.01	-	-
SEm±					0.74		0.71		0.67		0.78	0.85
CD (5%)			Sig		2.26		2.22		2.19		2.31	2.50
CV (%)					5.24		5.02		4.78		5.60	3.67

Figures in parentheses are angular transformed values

PTP: Pre-treatment population

DAS: Days After Spraying

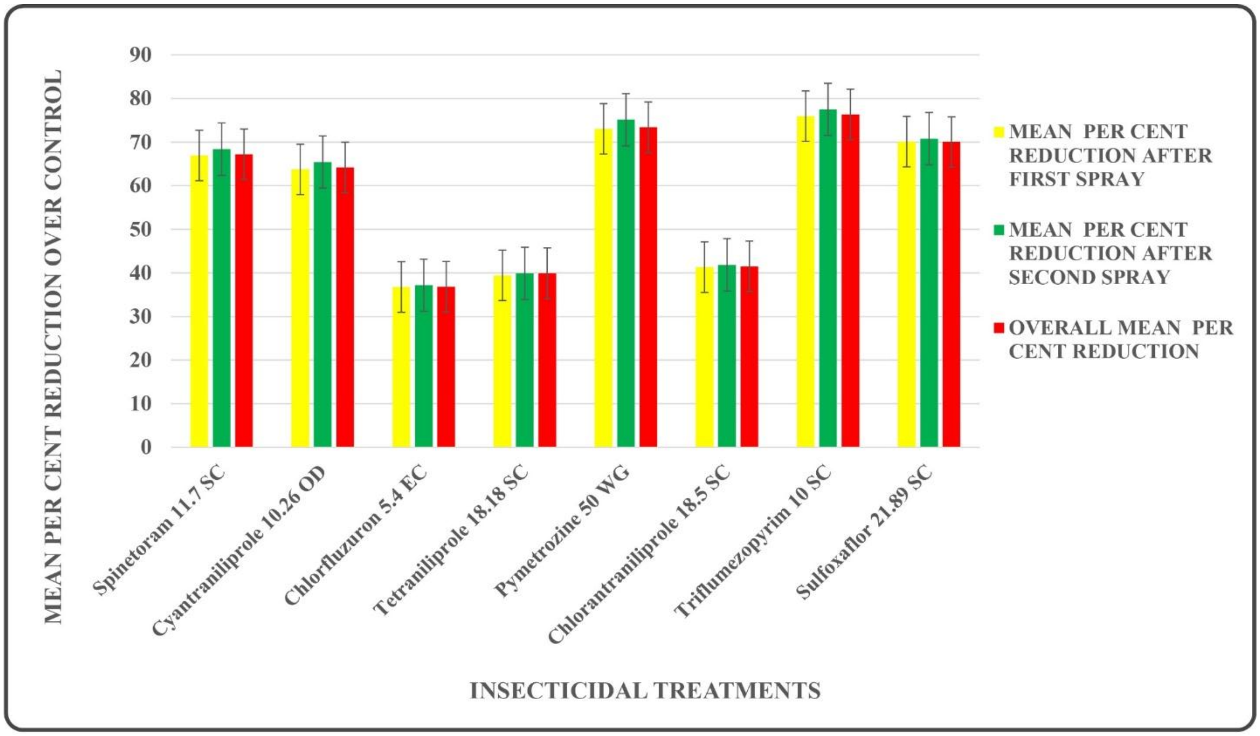

Fig. 2 : Mean effect of treatments after two sprays against white backed planthopper during *kharif*, 2022.

Table 3 : Overall cumulative efficacy of insecticides against Green Leafhopper (GLH), *Nephotettix virescens* during kharif, 2022

S.No.	Treatment	Dose	PTP 10^{-1} hills	Mean number of GLH per 10 hills and per cent reduction of GLH population over control after spraying								
				1DAS		5 DAS		10 DAS		15 DAS		Mean Per cent reduction
				Mean	Per cent reduction	Mean	Per cent reduction	Mean	Per cent reduction	Mean	Per cent reduction	
T_1	Spinetoram 11.7 SC	0.5 ml l^{-1}	257.11	67.60	74.60 ^{c} (59.81)	55.94	81.04 ^{cd} (64.23)	69.01	77.86 ^{c} (61.93)	200.15	38.50 ^{c} (38.36)	68.02 ^{c} (55.57)
T_2	Cyantraniliprole 10.26 OD	1.2 ml l^{-1}	260.67	79.87	70.43 ^{c} (57.09)	66.81	77.70 ^{d} (61.83)	85.06	73.03 ^{d} (58.75)	209.82	36.27 ^{d} (37.08)	64.40 ^{d} (53.37)
T_3	Chlorfluzuron 5.4 EC	2.0 ml l^{-1}	272.75	186.02	34.22 ^{e} (35.81)	153.57	51.01 ^{f} (45.58)	171.70	48.10 ^{f} (43.92)	295.52	14.22 ^{ef} (22.27)	36.96 ^{f} (37.44)
T_4	Tetraniliprole 18.18 SC	0.6 ml l^{-1}	258.68	163.36	39.07 ^{de} (38.73)	140.76	52.65 ^{ef} (46.55)	159.27	49.19 ^{ef} (44.55)	270.20	16.89 ^{e} (24.52)	39.62 ^{ef} (39.01)
T_5	Pymetrozine 50 WG	0.6 gm l^{-1}	253.94	41.41	84.03 ^{ab} (66.71)	38.39	86.87 ^{ab} (68.86)	48.66	84.17 ^{ab} (66.57)	179.71	44.03 ^{ab} (41.59)	74.82 ^{ab} (59.89)
T_6	Chlorantraniliprole 18.5 SC	0.3 ml l^{-1}	271.64	162.21	41.98 ^{d} (40.55)	140.93	54.92 ^{e} (47.83)	158.24	51.90 ^{e} (46.11)	274.85	19.73 ^{e} (26.51)	42.30 ^{e} (40.57)
T_7	Triflumezopyrim 10 SC	0.5 ml l^{-1}	246.58	30.68	87.97 ^{a} (70.02)	30.81	89.08 ^{a} (70.76)	41.54	86.02 ^{a} (68.12)	168.87	45.89 ^{a} (42.65)	77.27 ^{a} (61.54)
T_8	Sulfoxaflor 21.89 SC	0.7 ml l^{-1}	255.56	50.75	80.79 ^{b} (64.07)	45.93	84.29 ^{bc} (66.71)	55.52	82.02 ^{b} (65.04)	190.55	40.76 ^{bc} (39.76)	72.04 ^{b} (58.09)
T_9	Untreated control		259.60	269.36	-	298.59	-	314.83	-	328.65	-	-
SEm±					1.31		1.21		1.24		1.17	1.23
CD (5%)			Sig		3.85		3.64		3.71		3.46	3.68
CV (%)					5.75		6.94		6.79		8.18	6.85

Figures in parentheses are angular transformed values

PTC: Pre-treatment population

DAS: Days After Spraying

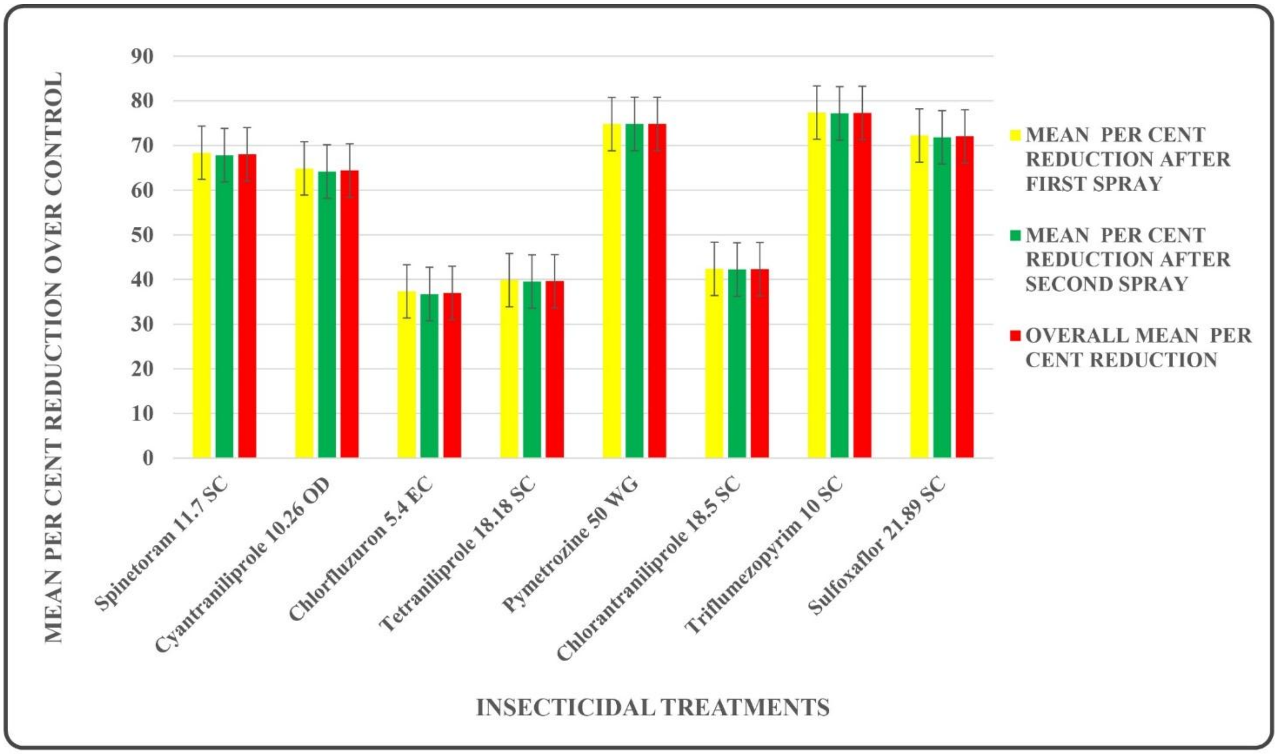

Fig. 3 : Mean effects of treatments after two sprays against green leafhopper during *kharif*, 2022

In the present investigation, triflumezopyrim 10SC @ 0.5 ml l^{-1} was found to be the most effective treatment which exhibited highest efficacy against sucking pest complex of paddy *viz*., *Nilaparvata lugens* (76.24 per cent reduction over control), *Sogatella furcifera* (76.33 per cent reduction over control), *Nephotettix virescens* (77.27 per cent reduction over control) and the results are in conformity with the findings of Suri and Makkar (2018) who revealed that triflumezopyrim 10.6 SC @ 35 and 25 g a.i. ha^{-1} were most effective in reducing the population of BPH recording 4.93 and 5.18 hoppers $hill^{-1}$ respectively. similar results were also reported by Sarao and Lakshmi (2020) who revealed that triflumezopyrim 10.6% SC @ 35 and 25 g a.i. ha^{-1} were effective in reducing the population of WBPH recording 1.77 and 2.43 hoppers $hill^{-1}$, respectively. Among the other treatments, pymetrozine 50 WG @ 0.6 gm l^{-1} was found to be the second best treatment against sucking pest complex of paddy *viz.*, *Nilaparvata lugens* (73.72 per cent reduction over control), *Sogatella furcifera* (73.38 per cent reduction over control), *Nephotettix virescens* (74.82 per cent reduction over control) and the results are in conformity with that of Deekshita and Ramarao (2018) who revealed that pymetrozine 50 WG @ 0.5 gm l^{-1} was found effective in reducing the population of BPH recording 62.98 per cent reduction over control. Similar results were also reported by Thorat *et al*. (2023) who revealed that pymetrozine 50WG @ 187.5 g a.i.ha^{-1} was effective in reducing the population of WBPH recording 7.82 hoppers $hill^{-1}$.

Conclusion

The efficacy of newer insecticides imposed at 40 and 60 DAT against major sucking pest complex *viz*., BPH WBPH and GLH revealed that all the treatments were superior over control and the treatment, triflumezopyrim 10 SC @ 0.5 ml l^{-1} recorded highest per cent reduction over control followed by pymetrozine 50 WG @ 0.6 gm l^{-1} against sucking pest and chlorantraniliprole 18.5 SC @ 0.3 ml l^{-1} recorded highest per cent reduction of incidence over control followed by tetraniliprole 18.18 SC @ 0.6 ml l^{-1} against lepidopteran pest. Therefore, the above insecticides fits very well into Integrated Pest Management programme and will be useful for farmers to manage these three major sucking pests in rice.

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